

TABLE 7-6 (continued).
FIELD ASSESSMENT CRITERIA AND THRESHOLDS (FROM R2 RESOURCES 2001).

Habitat Parameter	Habitat Condition		
	Good	Fair	Poor
Large Contained Stream (continued)			
Large woody debris	If CW is 33 to 66 feet, >0.50 key pieces/CW	If CW is 33 to 66 feet, 0.20 to 0.50 key pieces/CW	If CW is 33 to 66 feet, <0.20 key pieces/CW
	If CW<33 feet, >0.30 key pieces/CW and >2 total pieces/CW	If CW<33 feet, 0.15 to 0.30 key pieces/CW and 1-2 total pieces/CW	If CW<33 feet, <0.15 key pieces/CW and <1 total piece/CW
Moderate Gradient Mixed Control and Moderate Gradient Contained Streams			
Riparian condition	High recruitment potential	Medium recruitment potential	Low recruitment potential
Substrate composition in spawning areas	Gravel or cobble dominant	Gravel or cobble subdominant	Bedrock, boulder, sand or silt is dominant
Embeddedness	<20% in riffle and pool tailouts	20-40% in riffle and pool tailouts	>40% in riffle and pool tailouts
Bank condition	>80% of banks are vegetated and not artificially hardened Few side slope failures; where present, revegetation is well established	50-80% of banks are vegetated and not artificially hardened Side slope failures scarce, or if present, >50% are revegetated	>50% of banks are exposed soil or artificially hardened Side slope failures are common and actively eroding
Pool frequency	<2 CW/pool	2-4 CW/pool	>4 CW/pool
Channel pattern/bedform	Sinuuous pattern with well developed step-pool or pool- riffle bedform	Sinuuous pattern with irregular or poorly defined step-pool or pool-riffle bedform	Straightened pattern, plane- bed
Large woody debris	If CW is 33 to 66 feet, >0.50 key pieces/CW	If CW is 33 to 66 feet, 0.20 to 0.50 key pieces/CW	If CW is 33 to 66 feet, <0.20 key pieces/CW
	If CW<33 feet, >0.30 key pieces/CW and >2 total pieces/CW	If CW<33 feet, 0.15 to 0.30 pieces/CW and 1-2 total pieces/CW	If CW<33 feet, <0.15 key pieces/CW and <1 total piece/CW

TABLE 7-6 (continued).
FIELD ASSESSMENT CRITERIA AND THRESHOLDS (FROM R2 RESOURCES 2001).

Habitat Parameter	Habitat Condition		
	Good	Fair	Poor
High Gradient Streams			
Riparian condition	High recruitment potential	Medium recruitment potential	Low recruitment potential
Substrate composition in spawning areas	Gravel or cobble dominant	Gravel or cobble subdominant	Bedrock or boulder dominant
Embeddedness	N/A	N/A	N/A
Bank condition	Few side slope failures; where present, revegetation is well established	Side slope failures scarce, or if present, <50% are revegetated	Side slope failures are common and actively eroding
Pool frequency	<2 CW/pool	2-4 CW/pool	>4 CW/pool
Channel pattern/bedform	Well developed step-stool bedform	Irregularly spaced or poorly defined step-pool bedform separated by cascades	Cascade bedform
Large woody debris	If CW is 33 to 66 feet, >0.50 key pieces/CW	If CW is 33 to 66 feet, 0.20 to 0.50 key pieces/CW	If CW is 33 to 66 feet, <0.20 key pieces/CW
	If CW<33 feet, >0.30 key pieces/CW and >2 total pieces/CW	If CW<33 feet, 0.15 to 0.30 pieces/CW and 1-2 total pieces/CW	If CW<33 feet, <0.15 key pieces/CW and <1 total piece/CW
Note: CW = Channel Width			

Habitat Value and Rating

A qualitative assessment of each subbasin was conducted based on stream classification, complexity (number and size of the tributaries), and habitat potential (amount of spawning or rearing habitat). The value of each subbasin was classified as low, moderate, or high, depending on the amount of potential spawning and rearing habitat.

The habitat condition of each subbasin was rated as good, fair, or poor based on the existing conditions compared to what is described as natural conditions for the channel types described by the USBEM methodology. Stream reaches that provided highly suitable habitat were rated as “good;” reaches that have been degraded but still provided habitat use were rated as “fair;” and reaches with negligible habitat use or a portion of the salmonid life history habitat requirements that are significantly impaired were rated as “poor.”

State of the Subbasin

The “state of the subbasin” is a summary of the existing conditions and impairments to the habitat in each subbasin and identifies potential areas for habitat improvement projects and remaining high quality habitat areas suitable for preservation.

7.3 JUDD CREEK SUBBASIN 1 STREAM HABITAT CLASSIFICATION

7.3.1 General Characteristics

Judd Creek Subbasin 1 is primarily forested, with areas of rural residential and agricultural development. The stream habitat integrity has been conserved since the riparian buffer remains relatively intact. The main stem of Judd Creek is a moderate-gradient mixed-control channel type that flows downstream from the confluence of Judd Creek Subbasins 1 and 2 to the stream mouth (see Figure 7-3). This stream reach provides spawning and rearing habitat, as well as anadromous fish access to the upper two Judd Creek subbasins. Small high-gradient contained channel tributaries provide additional habitat. Subbasin 1 has approximately 12,500 feet of Class 2 stream.

7.3.2 Subbasin Alteration

Effective Impervious Area

Judd Creek Subbasin 1 is 1,080 acres in size and has 11 acres of impervious area, yielding a 1-percent EIA, a low level of alteration.

Landscape Alteration

Prior to development, 1,080 acres of mature forested land cover was present in Judd Creek Subbasin 1. Currently, 864 acres of forested land cover remain in the subbasin, 80 percent of the historical area, a low level of alteration.

Level of Impact from Culverts and other Crossings

Subbasin 1 has eight culverts, yielding 32 stream crossings/mile, a moderate level of impact. None of these culverts are barriers to fish passage.

Flow Modification

The hydrologic analysis indicates a low level of flow modification ($Q2_{\text{post}}/Q2_{\text{pre}} < 1.25$) in Judd Creek Subbasin 1 (Table 7-7).

Channel Modifications and Floodplain Connectivity

In Judd Creek Subbasin 1, Judd Creek flows through forested areas, with little alteration to the stream channel. The only significant alterations to the stream channel are at road crossings, where the stream is confined to culverts. The floodplain connectivity is good, with impairment occurring only at road crossings.

TABLE 7-7.
PRE-DEVELOPED AND POST-DEVELOPED 2-YEAR
FLOWS AND RATIO; RCHRES SEGMENT 100 AND 200
IN JUDD CREEK SUBBASIN 1

	RCHRES 100	RCHRES 200	RCHRES 300
Q _{2pre}	100 cfs	105	82
Q _{2post}	117 cfs	121	95
Q _{2post} /Q _{2pre} ratio	1.17	1.15	1.16

Riparian Alteration

In Judd Creek Subbasin 1, 84 percent of the riparian corridor is forested (56 of the 66 acres), a low level of alteration. There are 3.6 riparian breaks per mile in the subbasin, a moderate level alteration. The overall riparian alteration rating is moderate due to the moderate level of alteration based on riparian breaks. The riparian breaks are primarily due to stream-road crossings and are not lengthy reaches of degraded habitat.

Subbasin Alteration Matrix

A moderate level of subbasin alteration has occurred in Judd Creek Subbasin 1 (see Table 7-8). Riparian breaks and road crossings are the most significant habitat impairments in the subbasin.

TABLE 7-8.
SUBBASIN ALTERATION MATRIX FOR JUDD CREEK SUBBASIN 1

Criteria	Level of Alteration		
	High	Moderate	Low
Effective Impervious Area			1%
Landscape Alteration			80% forested
Impact from Culverts and Other Stream Crossings		3.2 crossings/mile	
Flow Modification (Q _{2post} /Q _{2pre} ratio)			1.15-1.17
Channel Modifications and Floodplain Connectivity			<10% modified
Riparian Alteration		3.6 breaks/mile	

7.3.3 Benthic Biodiversity

B-IBI data were collected in 1999, 2000, and 2001 by King County at Water Quality Sampling Station E1230, at the 216th Street SW road crossing. The low values for all of the parameters suggest that Judd Creek is in poor to very poor condition at this location (see Table 7-9). These results suggest a greater level of impact in Judd Creek Subbasin 1 than the other criteria and may indicate degradation further

upstream in the basin e.g. the channel erosion occurring east of 107th Avenue SW and north of SW 204th Street.

TABLE 7-9. B-IBI METRIC SCORES FOR JUDD CREEK AT SW 216 TH STREET			
	1999 5-Metric Score	2000 10-Metric Score	2001 10-Metric Score
Total No. Taxa	2	1	3
E Richness	1	1	1
P Richness	2	1	1
T Richness	3	1	1
% Dominance	4	3	3
Site Score	12	16	24

7.3.4 Subbasin 1 Summary

Field Investigation and Verification

Habitat conditions in Judd Creek Subbasin 1 were assessed at the SW 216th Street and 111th Avenue SW road crossings. Fish passage was “fair” in this reach of Judd Creek; the culvert at 111th Avenue had high velocities and may be impassable at some flows. The riparian habitat is dominated by deciduous trees and in good condition throughout this reach. Encroachment by residences into the riparian area occurs infrequently, with limited effects on the overall riparian habitat condition of the subbasin. However, these areas could cause localized bank instability, potentially leading to erosion of the stream channel and transport of fine sediments to downstream reaches. The substrate composition in spawning areas is dominated by gravels, in good condition, and with low embeddedness. Stream banks are well vegetated and in good condition throughout this reach. The channel pattern/bedform is sinuous and in good condition, with “good” pool frequencies, and “fair” LWD abundance.

Habitat Value

Judd Creek Subbasin 1 is a high value reach since it provides a diversity of habitats, abundant tributaries, and access to critical habitats in Judd Creek Subbasins 2 and 3. Because spawning and rearing habitat is present and supports an abundance of salmonids, this subbasin is an essential habitat resource for the Judd Creek Basin.

Rating

Overall, the stream habitat in Judd Creek Subbasin 1 is in “fair” condition. Development has moderately impacted habitat conditions, but suitable salmonid habitat remains. The longitudinal integrity of the riparian habitat has been interrupted and there are numerous culverts at road crossings. In addition, the B-IBI data indicate that the habitat has been degraded. The subbasin provides salmonid habitat, but the quality of the habitat has diminished.

State of the Subbasin

Rural residential and agricultural development has encroached on Judd Creek Subbasin 1, mostly away from the stream channel, thus preventing considerable degradation of the stream. Most of the basin remains forested and the riparian habitat is fairly intact with the exception of intermittent breaks at road crossings and residences. There are no extensive alterations to the stream channel, with the exception of channel constriction at road crossings and there is a fair abundance of LWD in the channel.

7.4 JUDD CREEK SUBBASIN 2 STREAM HABITAT CLASSIFICATION

7.4.1 General Characteristics

Subbasin 2 contains a left bank tributary to Judd Creek and a short reach of the Judd Creek main stem (see Figure 7-1). The tributary has approximately 2,600 feet of Class 2 stream. The subbasin is a mix of forested, rural residential, and agricultural areas. The stream is located in the more developed and impacted portion of the subbasin. The left bank tributary of Judd Creek that comprises the majority of subbasin 2 is a moderate gradient contained channel type, while the main stem Judd Creek is a moderate gradient mixed control channel type.

7.4.2 Subbasin Alteration

Effective Impervious Area

Judd Creek Subbasin 2 is 998 acres in size and has 28 acres of impervious area, yielding a 3-percent impervious area, a low level of alteration.

Landscape Alteration

Prior to development, 998 acres of mature forested land cover was present in Judd Creek Subbasin 2. Currently, 584 acres of forested land cover remain in the subbasin, 59 percent of the historical area, a high level of alteration.

Impact from Culverts and other Crossings

There are four stream crossings in Judd Creek Subbasin 2, yielding 2.3 stream crossings per mile, a moderate level of alteration. Although no barriers to fish passage have been identified in the subbasin, the road crossings should be monitored to avoid the development of a passage barrier.

Flow Modification

In Judd Creek Subbasin 2, the $Q2_{\text{post}}/Q2_{\text{pre}}$ ratio is 1.15 (Table 7-10), representing a low level of flow modification.

TABLE 7-10.
PRE-DEVELOPED AND POST-DEVELOPED 2-
YEAR AND RATIO; RCHRES SEGMENT 300 IN
JUDD CREEK SUBBASIN 2

Q _{2pre}	82 cfs
Q _{2post}	95cfs
Q _{2post} /Q _{2pre} ratio	1.15

Channel Modifications and Floodplain Connectivity

Alteration to the stream channel in Judd Creek Subbasin 2 has been minimal, with the exception of confinement of the stream into culverts at road crossings. Floodplain connectivity remains intact except for intermittent disturbance of the longitudinal integrity at road crossings.

Riparian Alteration

In Judd Creek Subbasin 2, 49 percent of the riparian corridor is forested (23 of 47 acres), a high level of alteration. There are 4.0 riparian breaks per mile, a moderate level of alteration. The overall riparian alteration rating is high due to the low percentage of forested land cover in the riparian corridor.

Subbasin Alteration Matrix

A high level of alteration has occurred in Judd Creek Subbasin 2 (Table 7-11). Alterations to the landscape and riparian alteration are the most significant habitat impairments in the subbasin.

7.4.3 Benthic Biodiversity

King County collected B-IBI data in 1999 at Water Quality Sampling Station E2756, at Cemetery Road in Judd Creek Subbasin 2. The scores developed from these data are presented in Table 7-12. The 1999 score of 15 classifies this reach as in “fair” condition based on the 5-metric method. These results correspond with the other criteria in this investigation that suggest that Judd Creek Subbasin 2 has been altered and the habitat is degraded.

TABLE 7-11.
SUBBASIN ALTERATION MATRIX FOR JUDD CREEK SUBBASIN 2

Criteria	Level of Alteration		
	High	Moderate	Low
Effective Impervious Area			3% EIA
Landscape Alteration	59% forested		
Impact from Culverts and Other Stream Crossings		2.3 crossings/mile	
Flow Modification (Q _{2post} /Q _{2pre} ratio)			1.16
Channel Modifications and Floodplain Connectivity			<10% of the channel altered
Riparian Alteration	49% forested		

TABLE 7-12.
B-IBI METRIC SCORES FOR JUDD CREEK
AT CEMETERY ROAD

	1999 5-Metric Score
Total No. Taxa	2
E Richness	3
P Richness	4
T Richness	3
Average E Richness	3
Average P Richness	2
Average T Richness	2
Site Score	15

7.4.4 Subbasin 2 Summary

Field Investigation and Verification

Habitat conditions in Judd Creek Subbasin 2 were assessed at the SW 204th Street and 107th Avenue SW road crossings. There were no fish passage barriers in this reach. The riparian habitat was in “fair” condition, with frequent encroachment by pastures and abundant Himalayan blackberry in some areas. The substrate in spawning areas was dominated by gravels and in “good” condition; embeddedness was low and in “good” condition.

Stream banks were well vegetated and in “good” condition in portions of the reach, however, encroachment by pastures and abundant blackberries reduced the rating to “fair” in more developed areas. The channel pattern/bedform ranged from “good” to “fair,” with moderate sinuosity, but infrequent step-pool formations upstream of 107th Avenue SW and confinement of a short reach by SW 204th Street. Pools were present, but only in “fair” quantities, and LWD quantities were “poor,” as none was seen.

Habitat Value

Judd Creek Subbasin 2 is a moderate habitat value reach that provides important spawning and rearing habitat to the Judd Creek basin. The subbasin is moderately complex, consisting of a branched tributary to Judd Creek and a portion of main stem Judd Creek. It provides 2.3 miles of potential habitat. Although the subbasin is likely a significant source of salmonid production for the Judd Creek Basin, habitat degradation likely impairs the potential production.

Rating

Judd Creek Subbasin 2 has received a moderate level of alteration, but remains in “fair” condition since it still supports salmonids. However, salmonid production may be limited in this subbasin by lack of channel and habitat complexity. The lack of LWD is probably responsible for the infrequent pools, limits channel and habitat complexity, and likely limits the production potential of the basin. Furthermore, the high level of impact on the riparian area is a significant impairment to the function of the system.

State of the Subbasin

Although Judd Creek Subbasin 2 has been significantly altered, suitable habitat remains. Although a high level of landscape alteration has occurred, this has not caused a corresponding significant increase in EIA, thus maintaining the hydrologic integrity of the subbasin. The riparian corridor is degraded and is likely resulting in impairment of the reach. Thus, restoration of the riparian habitat should be a primary habitat improvement goal for the subbasin. Increasing the habitat complexity should follow riparian habitat improvements.

7.5 JUDD CREEK SUBBASIN 3 STREAM HABITAT CLASSIFICATION

7.5.1 General Characteristics

Judd Creek Subbasin 3 has approximately 10,200 feet of Class 2 stream. It is dominated by forest with intermittent rural residential areas. A strip of rural residential/agricultural developed land follows much of the reach of Judd Creek in the subbasin and has degraded the habitat. The stream includes moderate-gradient contained, moderate-gradient mixed-control, and palustrine channel types (Figure 7-3)

7.5.2 Subbasin Alteration

Effective Impervious Area

Judd Creek Subbasin 3 is 1,214 acres in size and has 26 acres of EIA, yielding a 2percent EIA, a low level of alteration.

Landscape Alteration

Prior to development, 1,214 acres of forested land cover was present in Judd Creek Subbasin 3. Currently, 1,037 acres of forested land cover remain in the subbasin, 85 percent of the historical area, a low level of alteration.

Impact from Culverts and Other Crossings

Judd Creek Subbasin 3 has six culverts, yielding 2.6 stream crossings per mile, a moderate level of alteration. No passage barriers have been identified in the subbasin.

Flow Modification

The hydrologic analysis indicates a low level of flow modification ($Q_{2\text{post}}/Q_{2\text{pre}} < 1.25$) in Subbasin 1 (Table 7-13).

TABLE 7-13.
PRE-DEVELOPED AND POST-DEVELOPED 2-
YEAR FLOWS AND RATIO; RCHRES SEGMENT
400 IN JUDD CREEK SUBBASIN 3

$Q_{2\text{pre}}$	82 cfs
$Q_{2\text{post}}$	95 cfs
$Q_{2\text{post}}/Q_{2\text{pre}}$ ratio	1.15

Channel Modification and Floodplain Connectivity

Channel and flow modifications in Judd Creek Subbasin 3 are minimal. The existing alterations are at road crossings where the stream is confined to a culvert, and at residences and pastures, where riparian habitat degradation has affected the stream channel. Floodplain connectivity remains relatively unaltered, except for intermittent disturbances by road crossings.

Riparian Alteration

In Judd Creek Subbasin 3, 82 percent of the riparian corridor is forested (37 of 45 acres), a low level of alteration. There are six riparian breaks, yielding 3.5 riparian breaks per mile, which is a moderate level of alteration to the longitudinal integrity of the riparian corridor. The overall riparian alteration rating was moderate due to the abundance of riparian breaks. However, significant tracts of the riparian corridor have been severely degraded and are a considerable impairment to the habitat.

Subbasin Alteration Matrix

A moderate level of alteration has occurred in Judd Creek Subbasin 3 (Table 7-14). Riparian alteration and road crossings are the most significant habitat impairments in the subbasin; all other criteria were rated at a low level of alteration.

TABLE 7-14.
SUBBASIN ALTERATION MATRIX FOR JUDD CREEK SUBBASIN 3

Criteria	Level of Alteration		
	High	Moderate	Low
Effective Impervious Area			2% EIA
Landscape Alteration			85% forested
Impact from Culverts and Other Stream Crossings		2.6 crossings/mile	
Flow Modification ($Q_{2\text{post}}/Q_{2\text{pre}}$ ratio)			1.15
Channel Modifications and Floodplain Connectivity			<10% of the stream modified
Riparian Alteration		3.5 breaks/mile	

7.5.3 Benthic Biodiversity

King County collected B-IBI data in 2001 at Water Quality Sampling Station E2758, at Cemetery Road in Judd Creek Subbasin 3. The score of 22 classifies this reach as in “poor” condition based on the 10-metric method (see Table 7-15). These results correspond with the other criteria in this investigation suggesting that Judd Creek Subbasin 3 has been altered and the habitat has been impacted.

TABLE 7-15.
B-IBI METRIC SCORES FOR JUDD CREEK
AT CEMETERY ROAD IN SUBBASIN 3

	10-Metric Score
Total No. Taxa	3
E Richness	3
P Richness	1
T Richness	1
% Dominance	5
Site Score	22
Note: Scores from 1999 are based on the 5-metric method; scores from 2000 and 2001 are based on the 10-metric method	

7.5.4 Subbasin 3 Summary

Field Investigation and Verification

Habitat conditions in Judd Creek Subbasin 3 were assessed at the Singer Road and SW Cemetery Road crossings. Fish passage was good in the subbasin, with no barriers to fish migration. The riparian habitat is in “poor” condition due to severe degradation from grazing and removal of the vegetation at residences. Spawning habitat was not abundant in this reach. Where spawning habitat occurred, the substrate composition was rated “fair” because gravels were subdominant, and the embeddedness was rated “fair” due to moderate levels of fines. Stream banks were “poor” due to the lack of vegetation and trampling by

livestock, no pools were seen, the channel pattern/bedform was “poor” due to straightening and lack of complexity, and no LWD was seen.

Habitat Value

Judd Creek Subbasin 3 is a high value habitat area, providing important spawning and rearing habitat to the basin. This subbasin would have a high salmonid production potential in pristine conditions. However, significant lengths of the stream and riparian corridor have been impacted, limiting the potential salmonid production of the subbasin.

Rating

Although the segments of the Judd Creek stream habitat in Subbasin 3 have been impacted by grazing and rural residential land use practices, it remains in “fair” condition since it still supports salmonids. Portions of this subbasin appear relatively intact, while others are severely degraded. In these degraded segments, the riparian habitat has been totally removed, causing bank instability and erosion, which is likely also impacting downstream habitat conditions in the subbasin.

State of the Subbasin

In Subbasin 3, Judd Creek has been significantly altered by rural residential and agricultural development. Although the majority of the length of the riparian corridor is intact, the reaches adjacent to road crossings are degraded. In these reaches, the riparian habitat has been removed, resulting in destabilization of the stream banks and further degradation of the habitat. Habitat improvement projects in this subbasin should be directed at restoring the riparian habitat, then work toward improving habitat complexity.

7.6 SHINGLEMILL SUBBASIN 1 STREAM HABITAT CLASSIFICATION

7.6.1 General Characteristics

Shinglemill Subbasin 1 is dominated by a forested landscape, with a small area of rural residential and agricultural development in the southeast corner. Shinglemill Creek flows through a deep ravine through this reach. There is approximately 5,800 feet of Class 2 stream. The stream channel has a moderate-gradient in the upper reach of the subbasin, and a moderate-gradient mixed-control channel type in the lower 3,200 feet before entering Puget Sound (see Figure 7-3). Two lateral left bank tributaries have approximately 800 feet of Class 2 stream with a high-gradient and potential fish habitat.

7.6.2 Subbasin Alteration

Effective Impervious Area

Shinglemill Subbasin 1 is 316 acres in size and has 3 acres of EIA, yielding a 1-percent EIA, a low level of alteration.

Landscape Alteration

Prior to development, 315 acres of forested land cover was present in Shinglemill Subbasin 1. Currently, 282 acres of forested land cover remain in the subbasin, 89 percent of the historical area, a low level of alteration.

Impact from Culverts and other Crossings

Shinglemill Subbasin 1 has two stream crossing, yielding 1.6 stream crossings per mile. One of the crossings is the SW Cedarhurst Road crossing, and the other is a footbridge that crosses the stream as part of a trail created from an old road. There are no fish passage barriers in the subbasin.

Flow Modification

The hydrologic analysis indicates a low level of flow modification ($Q_{2\text{post}}/Q_{2\text{pre}} < 1.25$) in Shinglemill Subbasin 1 (Table 7-16).

TABLE 7-16. PRE-DEVELOPED AND POST-DEVELOPED 2-YEAR FLOWS AND RATIO; RCHRES SEGMENT 100 IN SHINGLEMILL SUBBASIN 1	
$Q_{2\text{pre}}$	70 cfs
$Q_{2\text{post}}$	84 cfs
$Q_{2\text{post}}/Q_{2\text{pre}}$ ratio	1.20

Channel Modification and Floodplain Connectivity

Channel and flow modifications are moderate in Shinglemill Subbasin 1. Alteration to the outflow of a wetland above Shinglemill Creek has caused mass wasting and transport of sediment to the stream channel. The resulting increase in sediment load to the stream appears to have caused some braiding of the channel and increased presence of sand. Additionally, low-level alterations occur at road crossings where the stream is confined to a culvert and where an old road reduces the width of the floodplain. The floodplain connectivity is relatively intact, except for disturbances at road crossings, and moderate encroachment on the floodplain by an old road for approximately a quarter-mile.

Riparian Alteration

The riparian habitat in Shinglemill Subbasin 1 was in good condition, as 98 percent of the riparian corridor was forested (44 of 45 acres), a low level of alteration. There were two riparian breaks, yielding 1.7 riparian breaks per mile, also a low level of alteration to the longitudinal integrity of the riparian corridor. The overall riparian alteration rating was low due to low values for both metrics.

Subbasin Alteration Matrix

A moderate level of subbasin alteration has occurred in Shinglemill Subbasin 1 (see Table 7-17). All of the criteria were rated at low levels of alteration except for the channel and floodplain alteration, which is representative of development in the subbasin.

TABLE 7-17.
SUBBASIN ALTERATION MATRIX FOR SHINGLEMILL SUBBASIN 1

Criteria	Level of Alteration		
	High	Moderate	Low
Effective Impervious Area			1% EIA
Landscape Alteration			89% forested
Impact from Culverts and Other Stream Crossings			1.6 crossings/mile
Flow Modification ($Q_{2\text{post}}/Q_{2\text{pre}}$ ratio)			1.20
Channel Modifications and Floodplain Connectivity		>10% modified	
Riparian Alteration			98% forested 1.6 breaks/mile

7.6.3 Benthic Biodiversity

King County collected B-IBI data in 1999 and 2000 at Water Quality Sampling Station E1236, at SW Cedarhurst Road in Shinglemill Subbasin 1 (see Table 7-18). The 1999 site score of 14 classifies this reach as in “fair” condition based on the 5-metric method, but the 2000 site score of 14 classifies this reach as in “very poor” condition. These results correspond with the degraded substrate conditions described in the WRIA 9 report due to the high sediment load in the stream from the mass wasting area.

7.6.4 Subbasin Summary

Field Investigation and Verification

Habitat conditions in Shinglemill Subbasin 1 were assessed in the reach extending upstream from SW Cedarhurst Road to the mouth of Dry Creek. Fish passage was rated as “good” since there were no barriers to fish movement. The riparian habitat was in “good” condition and dominated by deciduous trees. The substrate composition in spawning areas was dominated by gravels and in “good” condition. Embeddedness was rated as “fair” due to increased amounts of sand downstream of the mass wasting area known as the Grand Canyon of Shinglemill Creek. Upstream of the Grand Canyon embeddedness was “good”. Stream banks were well vegetated and in “good” condition. The channel pattern/bedform was sinuous and in “good” condition. Pool frequency was “fair” in this reach. Pools were frequent in the upstream areas, but became less frequent as the stream approached SW Cedarhurst Road. Large woody debris quantities were “fair” and similar to the distribution of pools, with greater quantities in the upstream reaches and lower quantities as the stream approached SW Cedarhurst Road.

TABLE 7-18. B-IBI METRIC SCORES FOR SHINGLEMILL CREEK AT SW CEDARHURST ROAD		
	1999	2000
Total No. Taxa	2	1
E Richness	2	1
P Richness	2	1
T Richness	3	0
Average E Richness	1.33	2
Average P Richness	0.67	1
Average T Richness	2.67	2
Site Score	14	14
Note: Scores from 1999 are based on the 5-metric method; scores from 2000 are based on the 10-metric method		

Habitat Value

Shinglemill Subbasin 1 is a high value area with abundant salmonid spawning and rearing habitat. Although this reach does not have any significant tributaries, both the stream channel and habitat complexity are high, which give the subbasin a high production potential. However, the prevalence of sand substrate likely limits salmonid production.

Rating

Shinglemill Subbasin 1 is in “good” condition since there have been few modifications to the stream channel, the riparian habitat, or the physical parameters of the stream. However, mass wasting has contributed a significant sediment load to the stream and has degraded the substrate conditions. Nonetheless, the stream still provides highly suitable spawning and rearing habitat.

State of the Subbasin

Shinglemill Subbasin 1 remains a forested landscape with minimal development. It provides suitable spawning and rearing habitat, as well as anadromous fish access to the other subbasins. Although neither the landscape nor the stream channel has been tremendously altered, human impacts are evident. Although the forest has recovered from logging, the long-term effects are evident in the lack of LWD in the lower portion of this reach. In the upstream areas of the subbasin, LWD is more abundant and is an important feature shaping the stream morphology and formation of pools. The Grand Canyon is a continual supply of fine sediment and sand to the stream, and appears to degrade the substrate conditions. The combination of limited LWD and apparently degraded substrate conditions in the lower reaches of this subbasin may be impairing potential fish production.

Restoration measures for this reach should first include a study of the effects of the increased sediment load from the Grand Canyon on Shinglemill Creek. It is possible that inserting additional LWD in the stream channel would improve the habitat complexity in this reach. However it may be necessary to reduce or eliminate the apparent sediment load from the Grand Canyon to realize the full benefits of inserting LWD into the stream channel.

7.7 SHINGLEMILL SUBBASIN 2 STREAM HABITAT CLASSIFICATION

7.7.1 General Characteristics

Shinglemill Subbasin 2 is the smallest of the four Shinglemill Creek subbasins and consists of Needle Creek, a right bank tributary to Shinglemill Creek, with its confluence at RM 1.1 (Figure 7-1). Needle Creek has approximately 2,200 feet of Class 2 stream. It has high-gradient contained channels that flow from a steep, narrow valley in the upper reaches of the subbasin down to the confluence with Shinglemill Creek (Figure 7-3). The landscape is dominated by forest with areas of rural residential development and agricultural land uses. The stream channel only flows through the southeastern corner of the subbasin. Fish usage is confined to the lower reaches because of the steep gradients in this subbasin.

7.7.2 Subbasin Alteration

Effective Impervious Area

Shinglemill Subbasin 2 is 310 acres in size and has 3 acres of EIA, yielding a 1-percent EIA, a low level of alteration.

Landscape Alteration

Prior to development, 310 acres of mature forested land cover was present in Shinglemill Subbasin 2. Currently, 220 acres of forested land cover remain in the subbasin, 71 percent of the historical area, a moderate level of alteration.

Impact from Culverts and Other Crossings

There are no culverts or stream crossings in Shinglemill Subbasin 2, thus culverts and crossings represent a low level of impact.

Flow Modification

Flow frequency analysis was not performed in Shinglemill Subbasin 2. However, since the other three subbasins all had low levels of hydrologic alteration, and the level of alteration to the remaining criteria was low, it is reasonable to expect that a low level of flow modification has occurred in this subbasin.

Channel Modification and Floodplain Connectivity

There have been no modifications to the stream channel, flows, or floodplain connectivity of Shinglemill Creek in Subbasin 2.

Riparian Alteration

In Shinglemill Subbasin 2, 96 percent of the riparian corridor is forested (26 of 27 acres), a low level of alteration. There are no riparian breaks, indicating a low level of alteration to the longitudinal integrity of the riparian corridor. The overall riparian alteration rating is low due to the low level of alteration indicated by both metrics.

Subbasin Alteration Matrix

A moderate level of subbasin alteration has occurred in Shinglemill Subbasin 2, due to landscape alteration (see Table 7-19). However, this alteration has occurred at a distance from the ravine that contains the stream, preventing significant impact on the stream, as indicated by the low level of alteration for all other criteria.

TABLE 7-19. SUBBASIN ALTERATION MATRIX FOR SHINGLEMILL SUBBASIN 2			
Criteria	Level of Alteration		
	High	Moderate	Low
Effective Impervious Area			1% EIA
Landscape Alteration		71% forested	
Impact from Culverts and Other Stream Crossings			0 stream crossings
Flow Modification ($Q2_{\text{post}}/Q2_{\text{pre}}$ ratio)			No data
Channel Modifications and Floodplain Connectivity			No modification
Riparian Alteration			96% forested no breaks

7.7.3 Benthic Biodiversity

No B-IBI data have been collected for Shinglemill Subbasin 2.

7.7.4 Subbasin Summary

Field Investigation and Verification

Habitat conditions in Needle Creek were assessed in the moderate-gradient reach directly upstream from the confluence with Shinglemill Creek. Fish passage was “good” in this reach since there were no anthropogenic barriers. The riparian habitat was dominated by deciduous trees and in “good” condition. The substrate in spawning areas was “good” and dominated by gravels. The spawning substrate was not embedded and in “good” condition. Stream banks were well vegetated and in “good” condition. The channel pattern/bedform was limited to “fair” due to infrequent step-pool formations. Both LWD quantities and pool frequency were rated as “fair” due to infrequent occurrences.

Habitat Value

Shinglemill Subbasin 2 is a moderate habitat-value reach. The majority of the basin has moderate to high gradients and provides limited spawning and rearing habitat. Although limited, salmonid habitat does exist in the subbasin.

Rating

Shinglemill Subbasin 2 has not been significantly altered and remains in “good” condition. Surrounding areas have been developed for agricultural and grazing uses, but these activities have not impinged on